

## Comparison of 3D scanned kidney stone model versus computer-generated models from medical images

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### ABSTRACT

With a goal to evaluate accuracy of kidney stone models created from medical images, comparison of computer-generated models against 3D scanned model is performed. Computer-generated models are made using 6 free and one commercial software for medical images obtained by computed tomography (CT) with a slice thickness of 5 mm. Digitized volume of the same kidney stone was obtained after its surgical removal and digitized using a contactless 3D scanner ATOS Compact Scan. Due to the complexity of kidney stone, the scanned reference model is not completely identical to real surgically removed stone from a patient. High maximum deviation is positioned mainly in the areas where the actual kidney stone is not scanned. The average surface deviation is in the range of 0.24354 mm to 0.44719 mm. Results reveals that the accuracy of the computer-generated models depends on quality of algorithms for tissue segmentation implemented in a particular software and on the skill of user. All software enabled us to create a 3D model of the kidney with clearly visible position of a kidney stone inside, accurate enough for planning the operation. It is possible to get a higher model accuracy by reducing the slice thickness during medical imaging; however, it increases the dose of radiation. Therefore, it is necessary to individually determine the optimum balance between the required quality of images and the amount of radiation that the patient is exposed to during recording.

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## Primerjava 3D skeniranega modela ledvičnega kamna z računalniško generiranimi modeli medicinskih slik

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### POVZETEK

S ciljem oceniti natančnost modelov ledvičnih kamnov, ustvarjenih iz medicinskih slik, je narejena primerjava računalniško generiranih modelov in 3D-skeniranih modelov. Računalniško generirani modeli so bili izdelani z uporabo šestih brezplačnih in ene komercialne programske opreme za medicinske slike, pridobljene z računalniško tomografijo (CT) z debelino rezin 5 mm. Digitalizirana prostornina enakega ledvičnega kamna je bila pridobljena po kirurški odstranitvi in digitalizaciji z brezkontaktnim 3D skenerjem ATOS Compact Scan. Zaradi kompleksnosti ledvičnega kamna, skenirani referenčni model ni popolnoma enak pravemu, pacientu kirurško odstranjenemu kamnu. Največja odstopanja so prisotna predvsem na območjih, kjer se dejanski ledvični kamen ne skenira. Povprečno odstopanje površine je v območju od 0,24354 mm do 0,44719 mm. Rezultati kažejo, da je natančnost računalniško generiranih modelov odvisna od kakovosti algoritmov za segmentacijo tkiv, ki so vključeni v določeni programske opreme in od znanja uporabnika. Vsaka programska oprema je omogočila izdelavo 3D modela ledvice, z jasno vidnim položajem notranjega ledvičnega kamna, ki je bil dovolj natančen za načrtovanje operacije. Večjo natančnost modela je mogoče doseči s stanjšanjem debeline rezine med medicinskim slikanjem, vendar je ob tem treba povečati odmerek sevanja. Zato je treba individualno določiti optimalno ravnotežje med zahtevano kakovostjo slik in količino sevanja, ki ji je izpostavljen bolnik med snemanjem.

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### PODATKI O ČLANKU

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